TRANSFLECTIVE LCD AND FABRICATING METHOD THEREOF

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Abstract of **KR20030008788**

PURPOSE: A transflective liquid crystal display device and a method for fabricating the same are provided to reduce the number of masks from 7 to 6 by forming an organic film on a lens part before forming gate wires. CONSTITUTION: A transflective liquid crystal display device includes an organic film(102) formed on a substrate with a lens part(105) formed of a concave and convex surface, gate electrodes(104a) formed on the organic film, a gate insulating film(106) formed on the gate electrodes and the organic film, an active pattern(108) formed on the gate insulating film on the gate electrodes, source and drain electrodes(112a,112b) formed on the gate insulating film and respectively overlapping both edges of the active pattern, a reflecting plate(112c) formed on the gate insulating film on the lens part on the same layer with the source/drain electrodes, an interlayer insulating film(114) formed on the source/drain electrodes, the reflecting plate and the gate insulating film and having contact holes(116) for exposing the source electrodes, and transparent electrodes(118) formed on the interlayer insulating film to be connected to the source electrodes via the contact holes.

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Abstract

Disclosed is the transreflective LCD and a method of manufacture thereof. The organic film having the lens unit made of the unevenness in the top of the substrate is formed. The gate electrode and gate insulating layer are successively formed on the organic film. The active pattern is formed on the gate insulating layer above the gate electrode. At the same time, the reflector corresponded to respective overlapped source electrode and drain electrode, and the lens unit to both side edge of the active pattern is formed on the gate insulating layer. The interlayer insulating film having the contact hole exposing the source electrode on the source / drain electrode, and a reflector and gate insulating layer is formed. The transparent electrode for the pixel electrode connected to the source electrode through the contact hole is formed on the interlayer insulating film. In the conventional 7 each the number of mask before forming the gate line, the lens unit the organic film is formed into the unevennesses, it reduces to 6 each. Therefore, the process is simplified and the manufacturing cost can be cut down.

Representative Drawing(s)

Fig.2

Description

■ Brief Explanation of the Drawing(s)

Figs. 1a and 1b are cross-sectional views for illustrating the manufacturing method of the conventional transreflective LCD.

Figure 2 is a cross-sectional view of the transreflective LCD.

Figs 3a through 3h are cross-sectional views for illustrating the manufacturing method of the transreflective LCD shown in fig. 2.

The description > of the denotation about the main part of ö drawing.

100: transparent substrate 102: organic film.

104a: gate electrode 104b: capacitor wire.

105: lens unit 106: gate insulating layer.

108: active pattern 110: contact layer pattern.

112a, 112b: source / drain electrode.

112c: reflector 114: interlayer insulating film.

116: contact hole 118: transparent electrode.

■ Background Art

The present invention relates to the transreflective LCD and a method of manufacture thereof, more particularly, to the transreflective LCD planning the processing simplification and can diminish the manufacturing cost and a method of manufacture thereof.

As to the information oriented society like a today, the role of the electronic display device is over the time important. And it is extensively used for the industry field in which all kinds of the electronic display devices is various.

Generally, the electronic display device refers to the apparatus for delivering the various information to the human through the sense of sight. That is, the electronic display device can define the electrical information signal outputted from all kinds of the electronic instruments as the electronic device for converting into the optic information signal which is able to recognized as the sense of sight of the human. And it can be defined as the apparatus for managing the bridging part of connecting the human and electronic device.

As to this electronic display device, it is called as the emissive display apparatus in case the optic information signal is indicated by an electroluminescence. And it is the optical modulation called with a reflection, a scattering, an interference etc. to the light-receiving display (non-emissive display) apparatus in case of being indicated. The cathode-ray tube (cathode ray tube: CRT), the plasma display panel (plasma display panel: PDP), the light emitting diode (light emitting diode: LED) and electroluminescent display (electroluminescent display: ELD) etc. can be given about the light emission type display apparatus for being called as the active display device. Moreover, in the non-emissive display device which is the passive display device, the liquid crystal display (liquid crystal display: LCD), the electrochemical display (electrochemical display: ECD) and electrophoretic image display (electrophoretic image display: EPID) etc. correspond to.

In the side including the display quality and profitability etc, the cathode-ray tube (CRT) used for the image display including the television or the computer momitor etc occupies the most high occupancy. But it has the disadvantage of being many including the heavy weight, the big volume and power consumption etc.

But the electronic display device which is suitable for the new environment, and the demand about the flat panel type display device equipped with that is, the feature of the low power consumption and the driving voltage low even when being thin and light drastically increase with the rapid progress of the semi-conductor technology with the solidification of the various electric apparatus, and the low voltage and low power consumption according to a miniature and light weight of the electronic device.

Presently, it is thin in comparision with other display device and the liquid crystal display is light among developed various flat panel display devices. And it is equipped with the low power consumption and the low driving voltage. In addition, the liquid crystal display is extensively used for the electronic device various because the image display which is near to the cathode-ray tube is possible.

The liquid crystal display is made of two substrates and the liquid crystal layer inserted into the interval. And an electrode is formed It controls amount of the light authorizing a voltage in an electrode and rearranges the liquid crystal molecules of the liquid crystal layer and is transmitted and it is the display device. In two substrates, respective electrode is formed. And the thin film transistor (thin film transistor: TFT) for switching the voltage applied in each electrode is formed in one substrate among two substrates.

In the meantime, the liquid crystal display can be classified into the transparent liquid crystal display device which indicates an image by using the external light source and the reflective liquid crystal display which instead of uses the natural light with external light source. It is general that in the electronic device which has to minimize the power consumption like a watch or a calculator, the reflective liquid crystal display is very much used. However, the transparent liquid crystal display device is used in the notebook computer demanding the image display of the large screan high definition.

So that the maximum high-definition image be implemented as the current trend while reducing the consumption of the electricity, the advantage of two branch types of a reflective and transmissive are altogether brought out and the transreflective LCD securing the proper visible line is developed in spite of the change of the peripheral brightness according to the use circumstance.

Figs. 1a and 1b are cross-sectional views for illustrating the manufacturing method of the conventional transreflective LCD.

Referring to Figure 1a, after the first metal layer for the gate line is deposited on the transparent substrate (10) consisting of glass, and a quartz or a sapphire, the first metal layer is patterned in the lithographically processing using the first mask and the gate electrode (12) and the gate line which is connected to the gate electrode (12) and includes the gate line (not illustrated) extended toward the first direction are formed.

The active layer and the n which after deposits the silicon nitride film on the gate line and substrate (10) and it forms the gate insulating layer (16), is made of the amorphous silicon film in the gate insulating layer (16).+The contact layer consisting of the doped amorphous silicon film is successively deposited. Subsequently, the contact layer and active layer are patterned in the lithographically processing using the second mask and the contact layer pattern (18) and active pattern (16) are formed. As to the contact layer pattern (18), in order to be comprised the ohmic contact between the source / drain electrode formed in the active pattern (16) and the upper part, it is formed.

After the second metal layer for data line is deposited on the front side of an outcome, the dataline (not illustrated) patterning the second metal layer in the lithographically processing of using the third mask and partitions off the pixel intersecting with the gate line and data line including source / drain electrodes (20a, 20b) are formed. And then, the contact layer (18) which is exposed by using the third mask is removed to the etching process. In that way the active pattern (16) in which the channel region is leaves

After it is a spin-coating and the photosensitive organic film the first insulating layer (22) serving of the protective film and interlayer insulating film is formed on the front side of an outcome, the first contact hole (24) which exposes a portion of the source electrode (20a) by it exposes the first insulating layer (22) by using the fourth mask and developing, is formed. At this time, the embossing (not illustrated) is formed on the surface of the first insulating layer (22) in order to make the reflector of a pixel a scatterer.

After the transparent conductive film such as the ITO (indium-tin-oxide) provided on the first contact hole (24) and the first insulating layer (22) to the permeable window and pixel electrode and IZO (indium-zinc-oxide) is deposited, the transparent conductive film is patterned to the lithographically processing of using the fifth mask. And then, the transparent electrode (26) connected through the first contact hole (24) to the source electrode (20a) is formed.

After the second insulating layer (28) is formed on the transparent electrode (26) and the first insulating layer (22), the second contact hole (29) etching the second insulating layer (28) to the lithographically processing of using the sixth mask and exposes a portion of the source electrode (20a) is formed.

After the reflective conductive film such as the aluminium (Al) provided on the second contact hole (29) and the second insulating layer (28) to a reflector and pixel electrode and silver (Ag) is deposited, the reflective conductive film is patterned to the lithographically processing of using the seventh mask. And then, the reflective electrode (30) connected through the second contact hole (29) to the source electrode (20a) is formed. At this time, as to the domain in which the reflective electrode (30) remains on the transparent electrode (26), the reflector (R) is. In as to only the transparent electrode (26), the domain remaining, the permeable window (T) is.

According to the above-described conventional transreflective LCD, it is necessary to have the lithographically processing or the exposure process of using the mask of 7 each of the total 7 layer of the reflective electrode and gate line, active layer, data line, the first contact hole, transparent electrode, second contact hole in order to design the reflection - transmissive structure.

Generally, as the number of photolithographies is increased, the probability of the progress error and process cost increases and an height is the manufacturing cost caused by. Therefore, the engineering development manufacturing the transreflective LCD with the process of being simplified of the level manufacturing the transparent liquid crystal display device is desperately requested.

■ The Technical Challenges of the Invention

Therefore, the first purpose of the present invention provides the transreflective LCD reducing the number of masks and can simplify the process.

The second purpose of the present invention provides the manufacturing method of the transreflective LCD reducing the number of masks and can simplify the process.

■ Structure & Operation of the Invention

The first purpose is accomplished. And the present invention is to provide the transreflective LCD which is formed on the interlayer insulating film and the interlayer insulating film having the contact hole which is formed on the active pattern: reflector: source / drain electrode which is formed on the gate insulating layer and is formed with both side edge of the active pattern on the gate insulating layer above respective overlapped source electrode and drain electrode: lens unit into the same layer as the source / drain electrode, and a reflector and gate insulating layer and formed on the gate insulating layer above the gate electrode: gate insulating layer: gate electrode formed on the gate electrode and organic film formed on the organic film: organic film exposes the source electrode and having the lens unit which is formed in the top of the substrate and is made of the unevenness includes the transparent electrode connected with the source electrode through the contact hole

A second, to accomplish the above objects. And the present invention is to provide the manufacturing method of the transreflective LCD including the step: step: forming the contact hole which partly etches the interlayer insulating film and exposes the source electrode and the step forming the transparent electrode connected with the source electrode through the contact hole on the interlayer insulating film forms the interlayer insulating film on the step: step: step: step: step: source / drain electrode that at the same time, forms the reflector corresponded to respective overlapped source electrode, the drain electrode and lens unit to both side edge

of the active pattern on the gate insulating layer, and a reflector and gate insulating layer forms the active pattern on the gate insulating layer above the gate electrode forms the gate insulating layer on the gate electrode and organic film forms the gate electrode on the organic film forms the organic film having the lens unit made in the top of the substrate of the unevenness.

According to the present invention, in the conventional 7 each the number of mask before forming the gate line, the lens unit the organic film is formed into the unevennesses, it reduces to 6 each. Therefore, the process is simplified and the manufacturing cost can be cut down.

Below, And hereinafter, preferred embodiments of the present invention will be described in detail with reference to the attached figures.

Figure 2 is a cross-sectional view of the transreflective LCD.

Referring to Figure 2, the organic film (102) having the lens unit (105) made of the unevenness in the transparent substrate (100) is formed. The lens unit (105) plays the role of diffusing the light penetrating the liquid crystal and improving the viewing angle. Preferably, the lens unit (105) is formed in order to have the tilt angle of 5°~15°.

The gate line consisting of the chrome (Cr) on the organic film (102), aluminium (Al), and the first metal layer including the molybdenum (Mo) or the molybdenum tungsten (MoW) etc is formed. The gate line provides the gate electrode (104a) of the thin film transistor which is the gate line (not illustrated) extended toward the first direction (that is, the traverse direction), and a portion of the gate line and the gate pad (not illustrated) which is connected to the end of the gate line and which is applied about the scanning signal from an outside and delivered to the gate line. Moreover, the bottom electrode (104b) of a capacitor is formed in the same layer as the gate line

The gate insulating layer (106) consisting of the inorganic material on the gate line and organic film (102), and for example, the silicon nitride is formed. The active pattern (108) and the n made of the semiconductor film like the amorphous silicon in the gate insulating layer (106) corresponding to the gate electrode (104a).+The contact layer pattern (110) consisting of the doped amorphous silicon film is successively laminated.

The data line consisting of the second metal layer is formed on the contact layer pattern (110) and gate insulating layer (106). The data line provides the dataline (not illustrated) extended toward the backward (that is, the longitudinal direction) that intersects with the gate line it is connected to first electrode (it says to be below, and the source electrode lice) (112a), overlapped with the first area of the active pattern (108) second electrode (it says to be below, and the drain electrode lice) (112b) overlapped with the second part faced with the first area of the active pattern (108), and the drain electrode (112b) and data pad (not illustrated) for being connected to the end of a dataline and delivering the picture signal to the thin film transistor. Moreover, the reflector (112c) consisting of the same layer as data line is formed on the gate insulating layer (106) corresponding to the lens unit.(105). At this time, as to the reflector (112c), the a part or the whole is electrically used as the upper electrode of a capacitor.

The interlayer insulating film (114) consisting of data line, the inorganic material on the reflector (112c) and gate insulating layer (106), and for example, the silicon nitride is formed. The contact hole (116) exposing the source electrode (112a) through the interlayer insulating film (114) is formed. Moreover, although not illustrated, contact holes are built up on the gate pad and data pad through the interlayer insulating film (114).

The transparent electrode (118) for the pixel electrode connected through the contact hole (116) to the source electrode (112a) is formed on the interlayer insulating film (114). Moreover, and data pad electrode are formed on the interlayer insulating film (114) with the same layer as the transparent electrode (118) in the gate pad and data pad.

The pixel electrode consisting of the transparent electrode (118) plays the role of receiving the picture signal from the thin film transistor and producing the electric field with the electrode (not illustrated) of the upper plate (that is, the color filter substrate). The pixel electrode is formed within the pixel segmented with the gate line and dataline. And in order to secure the high aperture ratio, the edge is overlapped with the gate line and dataline.

According to the present invention, after the reflector (112c) is formed into the same layer as source / drain electrodes (112a, 112b), the transparent electrode (118) is formed on the interlayer insulating film (114). Therefore, for the domain corresponding to the reflector (112c), the reflective region is. And for the domain which the transparent electrode (118) exists, the transmission region is

Figs. 3a through 3h are cross-sectional views for illustrating the manufacturing method of the transreflective LCD shown in fig. 2.

Referring to Figure 3a, the photosensitive organic film (102) is formed into the thickness more than about 1㎛ on the transparent substrate (100) consisting of glass, and the insulating material such as a quartz and sapphire with the spin-coating method.

Referring to Figure 3b, by by using the first mask, the organic film (102) being exposed and developing the lens unit (105) is formed on a portion of the organic film (102) into the unevenness. The lens unit (105) plays the role of diffusing the light penetrating the liquid crystal and improving the viewing angle. And it is formed preferably in order to have the tilt angle of 5°~15°.

Subsequently, in order to stabilize the organic film (102) having the lens unit (105) with an hardening, the thermal process is performed in a temperature more than 200℃ over the half an hour

Referring to Figure 3c, the first metal layer (103) including the chrome (Cr), the aluminium (Al), the molybdenum (Mo) or the molybdenum tungsten (MoW) etc. is deposited on the organic film (102) having the lens unit (105).

Referring to Figure 3d, the gate line patterning the first metal layer (103) in the lithographically processing of using the second mask and includes the gate line (not illustrated) extended toward the first direction (that is, the traverse direction), and the gate pad is formed. The gate pad (not illustrated) is formed within a pixel and is connected to the end of the gate line and the gate electrode (104a) which is a portion of the gate line and is formed in the pad area. Simultaneously, the bottom electrode (104b) of the capacitor consisting of the first metal layer is formed on the lens unit (105).

Referring to Figure 3e, the gate insulating layer (106) consisting of the inorganic insulaton film like the silicon nitride is formed into the thickness of about 4500Å on the gate line and organic film (102) with the chemical vapor deposition (it says to be "CVD" less than the chemical vapor deposition) process.

Subsequently, the semiconductor film like the amorphous silicon is deposited by the CVD alloy and the active layer (107) is formed on the gate insulating layer (106). A n on the active layer (107).+The doped amorphous silicon film is deposited by the CVD alloy and the contact layer (109) is formed. At this time, it is preferable that above-described CVD alloies perform in the low temperature less than 300C in order to minimize the affect about the organic film (102).

Referring to Figure 3f, the contact layer (109) and active layer (107) are patterned in the lithographically processing of using the third mask and the active pattern (108) and contact layer pattern (110) are formed on the gate insulating layer (106) above the gate electrode (104a). The contact layer pattern (110) plays the role of making the ohmic contact between the source / drain electrode formed in the active pattern (108) and the upper part and lowering a resistance.

Subsequently, the second metal layer (111) consisting of the metal in which the reflectivity is high is deposited on the contact layer pattern (110) and gate insulating layer (106).

Referring to Figure 3g, after the photoresist film is coated with on the second metal layer (111), the exposure development process of using the fourth mask is performed and the photoresist pattern (113) is formed.

Subsequently, data line which includes respective overlapped source electrode (112a) in both side edge of the active pattern (108) and drain electrode (112b) the second metal layer (111) dry is etched, and the dataline (not illustrated) extended toward the backward (that is, the longitudinal direction) that intersects with the gate line it is connected to the drain electrode (112b) and data pad for being connected to the end of a dataline and delivering the picture signal to the thin film transistor by using the photoresist pattern (113) as the etching mask is formed. Simultaneously, the reflector (112c) consisting of the second metal layer is formed on the gate insulating layer (106) corresponding to the lens unit (105). At this time, as to the reflector (112c), the upper electrode of a capacitor becomes electrically the a part or the whole. Therefore, it forms the storage capacitance with the bottom electrode (104b) of the capacitor consisting of the same layer as the gate electrode (112a).

Referring to Figure 3h, the contact layer pattern (110) which is exposed by using the photoresist pattern (113) as the etching mask is removed to the dry etch. And then, the active pattern (108) in which the channel region is remains.

After the photoresist pattern (113) is removed to an ashing and strip process, the inorganic insulator like the silicon nitride is deposited on the front side of an outcome and the interlayer insulating film (114) is formed. The contact hole (116) which partly etches the interlayer insulating film (114) to the lithographically processing of using the fifth mask and exposes the source electrode (112a) is formed

Subsequently, ITO or IZO is deposited to the thickness of about 500Å and the transparent conductive film (not illustrated) is formed on the contact hole (116) and interlayer insulating film (114). And then, the transparent conductive film is patterned in the lithographically processing of using the sixth mask and the transparent electrode (118) for the pixel electrode which as shown in Figure 2. is connected through the contact hole (116) to the source electrode (112a) is formed. And then, the reflective region and the transparent electrode (118) corresponding to the reflector (112c) the transreflective LCD at the same time, equipped with the transmission region existing is formed.

■ Effects of the Invention

As described above, the lithographically processing or the exposure process need in the total 6 layer of the transparent electrode and organic film, gate line, active layer, data line, the first contact hole in order to manufacture the transreflective LCD. That is, in the conventional 7 each the number of mask before forming the gate line, the lens unit the organic film is formed into the unevennesses, it can reduce to 6 each. Therefore, the process is simplified and the effect of the cost down can be obtained.

As described above, it will be able to understand to various, can change the present invention in the range that it does not deviate with reference to preferred embodiment of the present invention from the thought and domain of present invention in the estival patent claim it illustrated but it is the skilled person skilled in the art of the target technology part with a correction.

Scope of Claims

■ Claim 1:

The transreflective LCD comprising: the transparent electrode which formed is connected to the source electrode on the interlayer insulating film and the interlayer insulating film having the contact hole which is formed on the active pattern; reflector; source / drain electrode which is formed on the gate insulating layer and is formed with both side edge of the active pattern on the gate insulating layer above respective overlapped source electrode and drain electrode; lens unit into the same layer as the source / drain electrode, and a reflector and gate insulating layer and formed on the gate insulating layer above the gate electrode; gate insulating layer; gate

electrode formed on the gate electrode and organic film formed on the organic film: organic film exposes the source electrode through the contact hole having the lens unit which is formed in the top of the substrate and is made of the unevenness.

■ Claim 2:

The transreflective LCD of claim 1, wherein the tilt angle of the lens unit is 5°~15°.

■ Claim 3:

The transreflective LCD of claim 1, further comprising the bottom electrode of the capacitor formed on the organic film into the same layer as the gate electrode

■ Claim 4:

The transreflective LCD of claim 1, wherein the whole is used as the upper electrode of a capacitor in other words.

■ Claim 5:

The manufacturing method of the transreflective LCD comprising: the step: step: step: step: step: step: step: forming the contact hole which exposes the source electrode it etches the interlayer insulating film and the step forming the transparent electrode connected with the source electrode through the contact hole on the interlayer insulating film forms the interlayer insulating film on the front side of an outcome at the same time, forms the reflector corresponded to respective overlapped source electrode, the drain electrode and lens unit to both side edge of the active pattern on the gate insulating layer forms the active pattern on the gate insulating layer above the gate electrode forms the gate insulating layer on the gate electrode and organic film forms the gate electrode on the organic film forms the organic film having the lens unit made in the top of the substrate of the unevenness.

■ Claim 6:

The manufacturing method of the transreflective LCD of claim 5, wherein the step forming the organic film is made of the step forming the lens unit consisting of the step coating the top of the substrate with the organic film, and the unevenness by using the first mask. it exposes and develops the organic film.

■ Claim 7:

The manufacturing method of the transreflective LCD of claim 6, further comprising the step that performs the thermal process in a temperature more than 200°C over the half an hour in order to stabilize the organic film after the step forming the lens unit

■ Claim 8:

The manufacturing method of the transreflective LCD of claim 5, wherein the lens unit forms in order to have the tilt angle of 5°~15°.

■ Claim 9:

The manufacturing method of the transreflective LCD of claim 5. wherein it is made of the step that successively deposits the active layer and contact layer on the gate insulating layer in a temperature less than 300 C, and the contact layer pattern and the step forming the active pattern the step taking shape the active pattern patterns the contact layer and active layer.

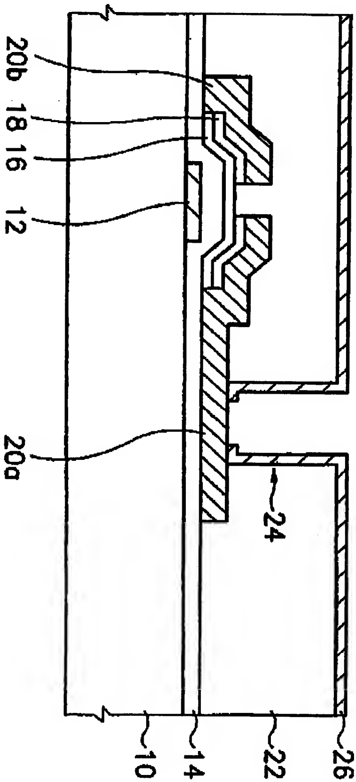
■ Claim 10:

The manufacturing method of the transreflective LCD of claim 5, wherein in the step forming the gate electrode, at the same time, the

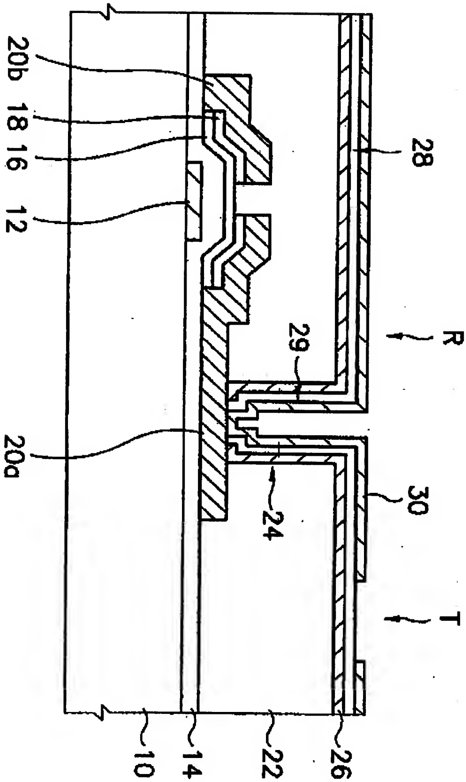
bottom electrode of a capacitor is formed.

Drawings

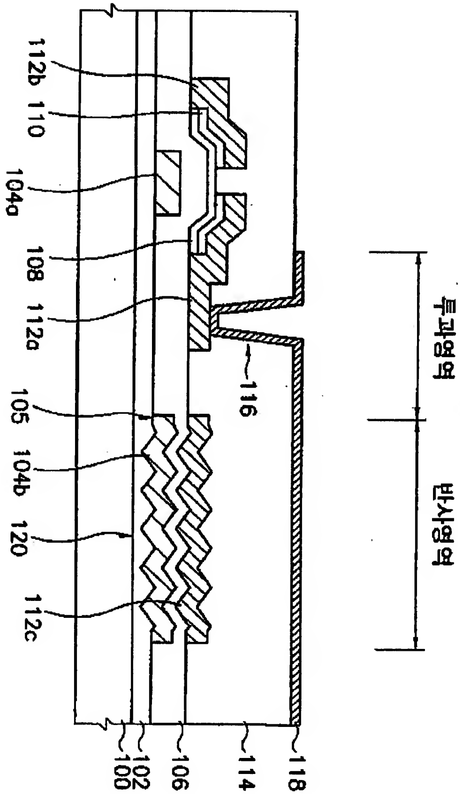
■ Fig. 1a



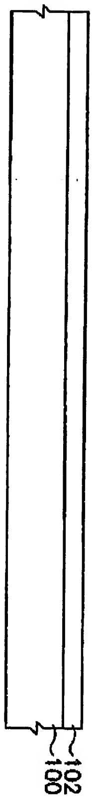
■ Fig. 1b



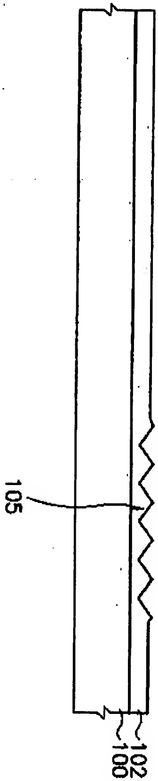
■ Fig. 2


112b
110
104a
108
112a
105
104b
120
112c
116
투과영역
반사영역
100
102
106
114
118

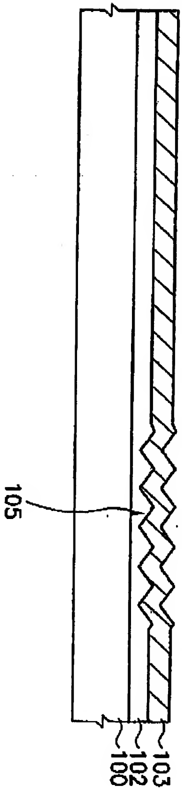
■Fig 3a



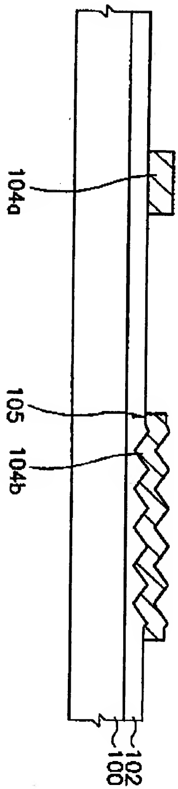
■ Fig. 3b



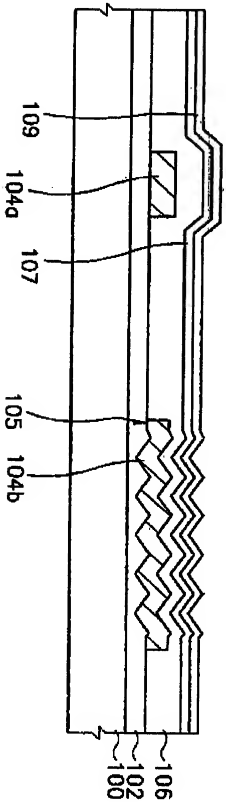
■ Fig 3c



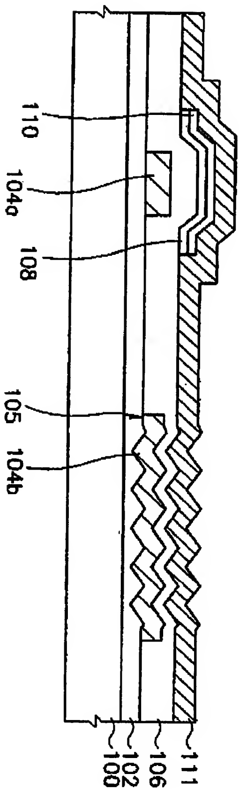
■ Fig. 3d



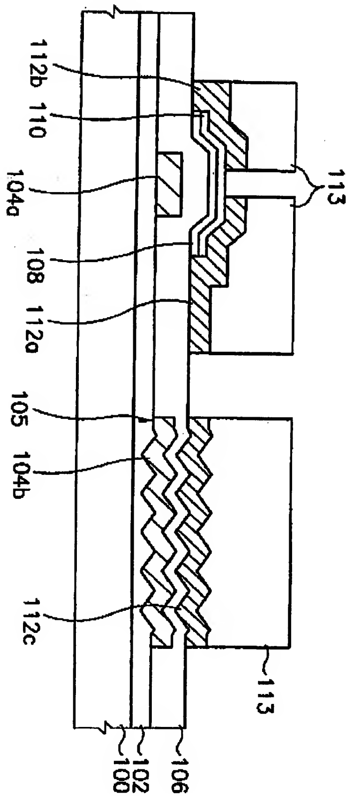
■Fig 3e



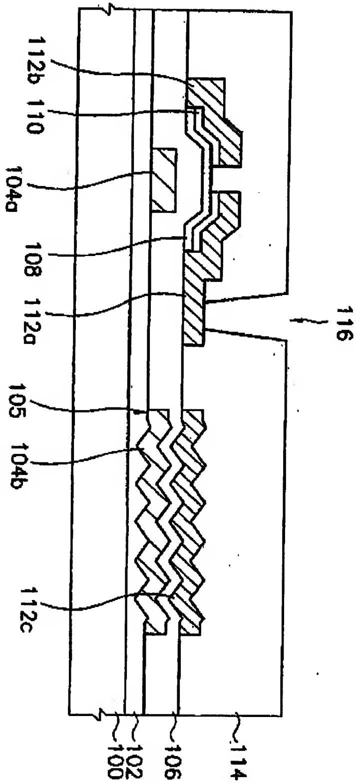
■ Fig 3f



■ Fig. 3g



■Fig 3h



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